Bob's Rule

1) Avoid LOSERS at all costs.
2) The world is FULL of LOSERS

$$\boxed{\text{Your success will be determined by your success in balancing these two things}}$$

3.3/5

$$\frac{d}{dx}\left(\pi^3\right) = \frac{d}{dx}\left(\pi^3 x^0\right)$$

$$= \pi^3 \frac{d}{dx}\left(x^0\right) = \pi^3\left(0 \cdot x^{-1}\right)$$

$$= 0$$

3.3/8

$$y = \frac{x^2+1}{5}$$

$$\frac{d}{dx}\left(\frac{x^2+1}{5}\right) = \frac{d}{dx}\left(\frac{x^2}{5}\right) + \frac{d}{dx}\left(\frac{1}{5}\right)$$

$$= \frac{1}{5}\frac{d}{dx}(x^2) + 0$$

$$= \frac{1}{5}(2x) = \frac{2}{5}x$$

$$\frac{d}{dx}\left(\frac{x^2+1}{5}\right) = \frac{1}{5}\frac{d}{dx}(x^2+1)$$

$$= \frac{1}{5}(2x+0)$$

9) $\frac{d}{dx}(ax^3+bx^2+cx+d)$

$= a(3x^2)+b(2x)+c(1)+d(0)$

$= 3ax^2+2bx+c$

11)

$$y = -3x^{-8} + 2\sqrt{x}$$

$$\lim_{w \to x} \frac{\left(-3w^{-8} + 2w^{1/2}\right) - \left(-3x^{-8} + 2x^{1/2}\right)}{w - x}$$

$$\frac{d}{dx}\left(\left(-3x^{-8}\right) + \left(2x^{1/2}\right)\right)$$

$$= (-3)\left(-8x^{-9}\right) + 2\left(\frac{1}{2}x^{-\frac{1}{2}}\right)$$

$$= 24x^{-9} + x^{-1/2}$$

$$= \frac{24}{x^9} + \frac{1}{\sqrt{x}}$$

12) $7x^{-6} - 5\sqrt{x}$

$$\frac{d}{dx}\left(7x^{-6} - 5\sqrt{x}\right)$$

$$= -42x^{-7} - \frac{5}{2\sqrt{x}}$$

$\frac{dy}{dx}(3x)$

take the derivative of y (wrt x) & multiply it by 3x

$\frac{d}{dx}(3x)$

y

derivative of (3x) w.r.t. x

$y = 3x$

find $\frac{dy}{dx}$

$\frac{dy}{dx}$ "take the derivative of y with respect to x"

$y = 2x + 1$

what is y when x has the value of two.

$f(2)$ when $f(x) = 2x + 1$

$f(x) = x^2 \cdot x^2$

what is $f'(x)$?

Is there a rule for products?

$x^2 \cdot x^2 = x^4 = f(x)$

so $f'(x) = 4x^3$

Product rule is complicated.

General form of

Product Rule

Let $f(x)$ & $g(x)$ be f^{n}s denoted just by f and g [[really lazy or mnemonic]]

$$(fg)' = f'g + fg'$$

Ex

$$\frac{d}{dx}\left(\underset{f}{x^2}\cdot\underset{g}{x^2}\right) = \overset{f'}{(2x)}\overset{g}{(x^2)} + \overset{f}{(x^2)}\overset{g'}{(2x)}$$

$$= 2x^3 + 2x^3 = 4x^3$$

$$\frac{d}{dx}\left(\underset{f}{x^2}\underset{g}{(x^2+2)}\right) = \underbrace{\underset{f'}{(2x)}\underset{g}{(x^2+2)}}\underbrace{+\underset{f}{(x^2)}\underset{g'}{(2x)}}$$

OR $2x(x^2+2+x^2)$

OR $= 2x(2x^2+2)$

One more Rule...

Quotient Rule

What about dividing?

$$\frac{d}{dx}\left(\frac{f}{g}\right) = \frac{f'g - fg'}{g^2}$$

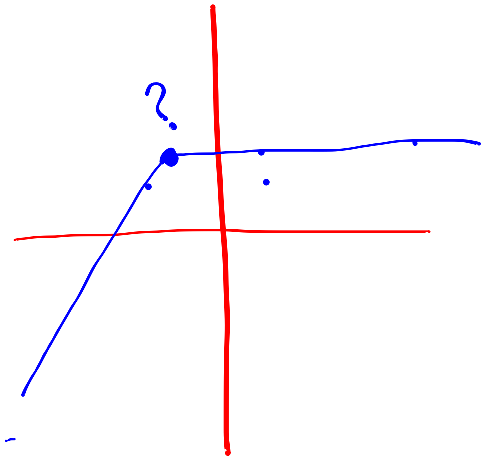
$$\frac{d}{dx}\left(\frac{x^2}{x^2}\right) = \frac{(2x)(x^2) - (x^2)(2x)}{(x^2)^2}$$

$$\frac{d}{dx}(1) = \frac{2x^3 - 2x^3}{x^4} = 0$$

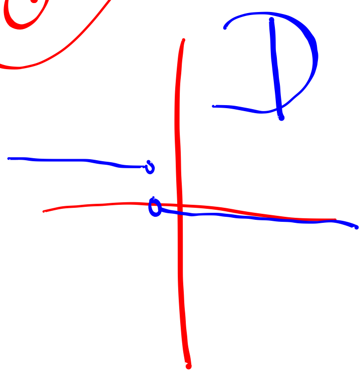
Huh?

$\Rightarrow$ proofs in book

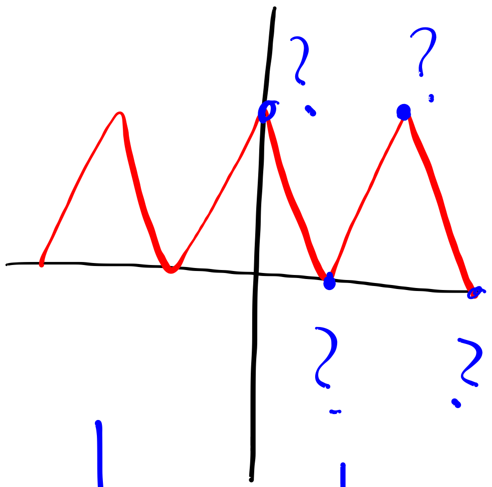
3.2 #23 (a)

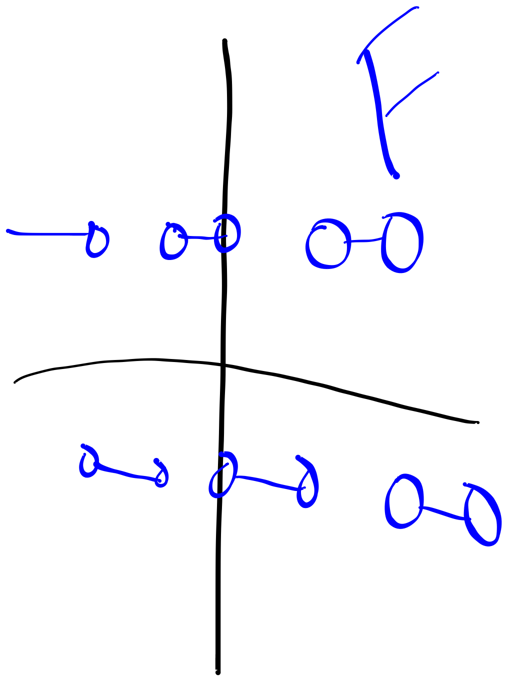


deriv



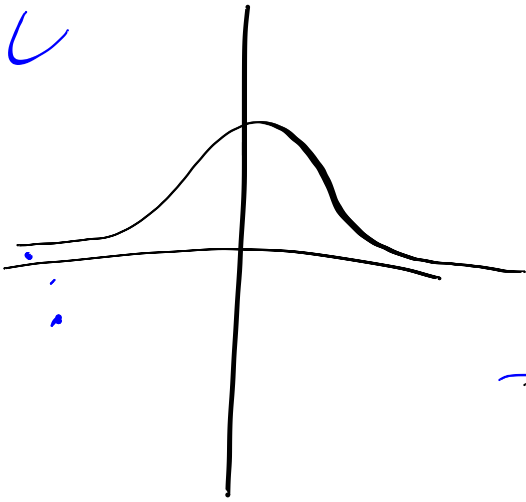
23b



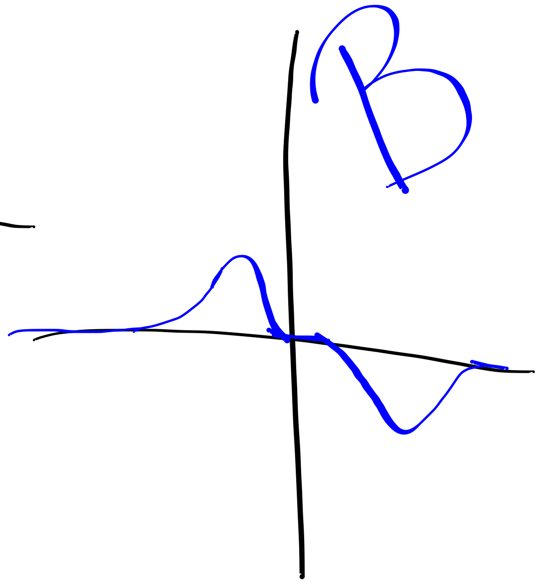


No derivative at corner

23c



B



3.2/19 $y = \frac{1}{\sqrt{x}}$

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x} = \lim_{\Delta x \to 0} \frac{\frac{1}{\sqrt{x+\Delta x}} - \frac{1}{\sqrt{x}}}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{\sqrt{x} - \sqrt{x+\Delta x}}{(\Delta x)\sqrt{x}\sqrt{x+\Delta x}} \cdot \frac{\sqrt{x} + \sqrt{x+\Delta x}}{\sqrt{x} + \sqrt{x+\Delta x}}$$

$$= \lim_{\Delta x \to 0} \frac{(x - (x+\Delta x))}{(\Delta x)\sqrt{x}\sqrt{x+\Delta x}(\sqrt{x} + \sqrt{x+\Delta x})}$$

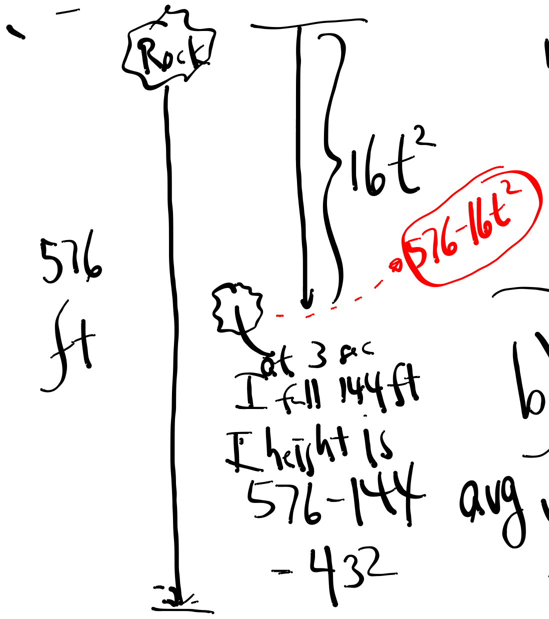
$$= \lim_{\Delta x \to 0} \frac{-\Delta x}{(\Delta x)\sqrt{x}\sqrt{x+\Delta x}(\sqrt{x} + \sqrt{x+\Delta x})}$$

$$= \lim_{\Delta x \to 0} \frac{-1}{\sqrt{x}\sqrt{x+\Delta x}(\sqrt{x} + \sqrt{x+\Delta x})}$$

$$= \frac{-1}{\sqrt{x}\sqrt{x}(\sqrt{x} + \sqrt{x})} = \frac{-1}{x^{1/2}x^{1/2}(2x^{1/2})}$$

$$= \frac{-1}{2x^{3/2}}$$

3.1/18



at 3 sec
I fall 144 ft
I height is
$576-144$
$=432$

a) when Rock hit ground?
must fall 576 ft.

$576 = 16t^2$

$36 = t^2$

$t = \pm 6$ sec

b) What avg velocity 0-6 sec?

avg velocity =

pt 1: $t=0$, $h=576$ ft

pt 2: $t=6$, $h=0$

avg vel: $\dfrac{576-0}{0-6} = -96$ ft/sec

c) avg vel for first 3 sec?

$$\frac{576-432}{0-3} = \frac{144}{-3} = -48 \text{ ft/sec}$$

d)

$$V_{inst} = \lim_{t_1 \to t_0} \frac{f(t_1)-f(t_0)}{t_1-t_0} = \lim_{t_1 \to t_0} \frac{(576-16t_1^2)-(576-16t_0^2)}{t_1-t_0}$$

$$= \lim_{t_1 \to t_0} \frac{16t_0^2-16t_1^2}{t_1-t_0} = \lim_{t_1 \to t_0} -16(t_0+t_1) = -32t_0$$

at $t_0 = 6$ ... $V_{inst} = (-32)(6) = -192$ ft/sec

3.3/8 $y = \frac{x^2+1}{5}$. find $\frac{dy}{dx}$.

$$\frac{d}{dx}\left(\frac{x^2+1}{5}\right) = \frac{1}{5}\frac{d}{dx}(x^2+1) = \frac{1}{5}(2x) = \frac{2}{5}x$$

$$\frac{d}{dx}\left(\frac{1}{5}x^2+\frac{1}{5}\right) = \frac{1}{5}(2x)+\frac{1}{5}(0) = \frac{2}{5}x$$

3.3 11)

$$\frac{d}{dx}\left(-3x^{-8}+2\sqrt{x}\right)$$

$$\frac{d}{dx}\left(x^{1/2}\right)=\frac{1}{2}x^{-1/2}$$

$$=-3\frac{d}{dx}\left(x^{-8}\right)+2\frac{d}{dx}\left(\sqrt{x}\right)$$

$$=-3\left(-8x^{-9}\right)+2\left(\frac{1}{2\sqrt{x}}\right)=\frac{24}{x^{9}}+\frac{1}{\sqrt{x}}$$

Product Rule

$$(f\cdot g)' = f'g + fg'$$

$$\frac{d}{dx}\left(\underset{f}{x^2}\cdot \underset{g}{x^3}\right) = \underset{f'}{(2x)}\underset{g}{(x^3)} + \underset{f}{(x^2)}\underset{g'}{(3x^2)}$$

$$= 2x^4 + 3x^4 = 5x^4$$

$$\frac{d}{dx}\left(x^5\right)$$

CAUTION

Extremely streamlined notation (i.e. illegal) to aid w/ memory

Quotient Rule

$$\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$$

$$\frac{d}{dx}\left(\frac{\overset{f}{1}}{\underset{g}{x}}\right) \overset{Q}{=} \frac{\overset{f'}{(0)}\overset{g}{(x)} - \overset{f}{(1)}\overset{g'}{(1)}}{\overset{g}{(x)}^2} = \frac{-1}{x^2}$$

PR

$$\frac{d}{dx}\left(x^{-1}\right) = -1x^{-2} = \frac{-1}{x^2}$$

$$(fg)' = f'g + fg' \qquad \left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$$

$$\left(\frac{fg}{h}\right)' = \left(\frac{(fg)}{h}\right)' = \frac{(fg)'(h) - (fg)(h')}{(h)^2}$$

$$= \frac{(f'g + fg')(h) - (fg)(h')}{h^2}$$